

The origin, formation and zoogeography of endemic spiders of Bulgaria (Araneae)

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The origin, formation and zoogeography of endemic spiders of Bulgaria (Araneae). - All data available on the so called "endemic" taxa of spiders (Araneae) in Bulgaria are comprised, revised and discussed. The researches cover 43 species from 21 genera and 10 families, and represent 5.7% from Bulgarian spiders. They are most richly represented in Pirin Mnt. 18 (41.86%), Rila Mnt. 15 (34.88%), West Rhodopes Mnt. 11 (25.58%) and West Stara planina Mnt. 8 (18.60%), comparatively well in Vitosha Mnt. 6 (13.95%), Osogovo Mnt. 6 (13.95%), Central Stara planina Mnt. 3 (6.97%), Black Sea coast 3 (6.97%) and weakly in East Stara planina mnt. 2 (4.65%), East Rhodopes 1(2.32%), Zemenska planina mnt. 1(2.32%) and Struma valley 1 (2.32%). The largest fraction of endemics was encountered mainly in the mountains, where they inhabit the high altitude zone, forest belt, and caves. The greatest number of local endemics is established in high altitude and woodland zone of Pirin (15) and Rila (13) and in caves and woodland zone of West Rhodope (6) and West Stara planina (6). These regions and districts can be regarded as possible centres of speciation. The phenomenon can be regarded as a result of the relative isolation of the mountains compared with the zonal areas, in the context of paleo-environmental changes since Pliocene.

Key-words: Araneae - endemics - Bulgaria - Balkan peninsula.

INTRODUCTION

The hitherto faunal investigations show that the Bulgarian spider fauna is diverse and rich but a complex research on the endemic taxa is not realised at all. The main information on the taxa discovered and described from Bulgaria can be found in the papers of DRENSKY (1915, 1921, 1931,1940), BUCAR (1968) and DELTSHEV (1972, 1973*a, b*, 1974, 1975, 1977, 1978, 1980, 1983*a, b, c*, 1984, 1985, 1987, 1988*a, b*, 1990*a, b*, 1992, 1993). The pooling of all available literature records and the

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accumulation of new data makes possible a critical review on all of so called "endemic" taxa together with zoogeographical analysis and discussion on their origin and formation.

STUDY AREA AND METHODS

Bulgaria is situated in Balkan peninsula and took its eastern part (fig. 1). The investigations were directed to all geographic regions of Bulgaria, but the endemic taxa were found mainly in the mountains: Pirin, Rila, Rhodopes, Stara planina, Slavianka, Vitosha, Osogovo and Zemenska planina. There are also a few localities in the lowlands of Black Sea coast and Struma valley. The question about the status and distribution of endemic spiders found in Bulgaria is complicated. Some of them are found only in restricted areas (even in a single caves) while the other ones show larger distribution, including some of adjacent territories as North Turkey, North Greece, Macedonia, Serbia, South Romania. Certainly, some of the widespread in Bulgaria endemics is possible to be found in the neighbouring territories and to be put into the group of Balkan species. Obviously, the endemic spiders of Bulgaria can not be regarded separately from Balkan peninsula and terms as Bulgarian, Balkan and local endemics are used in the discussion. The program BIODIV (BAEV & PENEY 1994) is used for the calculation of Czekanovski-Sorensen similarity index, calculated by average linkage method and for dendrogram constructing.

RESULTS

The contribution is due to a critical revision of all data available on the endemic spiders established in Bulgaria and comprises 43 species from 21 genera and 10 families: Dysderidae 2, Leptonetidae 2, Zodariidae 3, Nesticidae 1, Tetragnathidae 1, Linyphiidae 22, Lycosidae 2, Agelenidae 10, Amaurobiidae 1, Thomisidae 1 (tabl. 1). The number of established species represents 5.7% from the number of all Bulgarian spiders. The most characteristic families are: Linyphiidae *s.l.* 51.16% and Agelenidae 23.25%. The most numerous genera are: *Leptyphantus* with 7, *Centromerus* with 5 species and *Coelotes* with 4 species, but very important is the endemic genus *Antrohyphantus* with 3 species known from caves and from outside localities (fig. 1). The genera *Coelotes* and *Tegenaria* are also represented by three species. Some interesting new records are:

Dasumia kucseri (Kratochvíl), known only from Shar mountain (Macedonia);

Disdera pectinata Deeleman, described from district of Ochrid lake (Macedonia) and Pind mountain (Greece);

Zodariion ochridense Wunderlich, known only from district of Ochrid lake.

The endemic taxa of spiders in Bulgaria (Bulgarian/Balkan) are distributed in the regions and districts as follow:

In mountains: Pirin 16/2 (41.86%); Rila 14/1 (34.88%); West Rhodope 7/4 (25.58%); West Stara planina 6/2 (18.60%); Vitosha 4/2 (13.95%); Osogovo 2/4

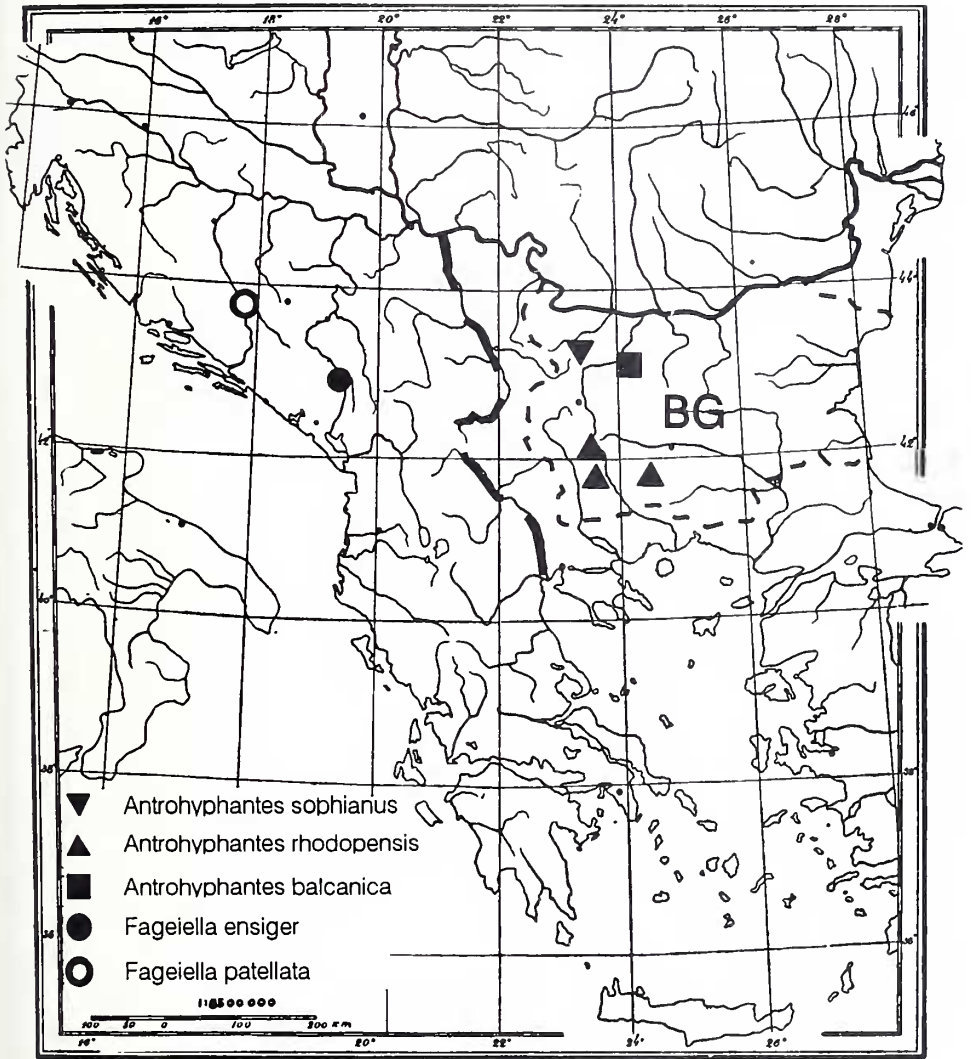


FIG. 1

Distribution of the species of *Antrohyphantes* and *Fageiella*, with border (in bold lines) between West and East parts of the Balkan peninsula.

(13.95%); Central Stara planina 2/1 (6.97%); East Stara planina 1/1 (4.65%); East Rhodope 1/ (2.32%); Zemenska planina 1/ (2.32%); Slavianka /1 (2.32%) (tabl. 1, fig. 2, fig. 3).

In lowlands: Black sea coast 2/1 (6.97%); Struma valley 1 (2.32%) (tabl. 1) (fig. 2). According to their ecological preferences, they can be grouped as follows: high-mountain, caves, woodland (mountain) and lowland (tabl. 1). The group of endemic spiders inhabiting the high altitude zone includes 18 species and represents 41.86% from the number of all endemics. They are distributed in the mountains: Pirin 14/2, Rila 13/1, West Rhodope 3 and Vitoshka 3. Only the mountains of Rila and Pirin have real high alpine belt and this is the reason for the high similarity (70%) in species composition of endemics (fig. 4). The high altitude zones of the mountains of Vitoshka and West Rhodope comprise only the subalpine belt and the similarity with the endemics of Pirin and Rila is at a low level (35%).

According to their origin, the endemics form two groups. Some of the species can be regarded as probable remnants of ancient Mediterranean mountain fauna (paleoendemics) and the other ones, which have come from the northern parts of Europe during the glacials and evolved under isolation in mountain during the interglacials (neoendemics). The curious distribution of *Antrohyphantes rhodopensis*, found only at high altitude zone and in caves, speaks for a relic of ancient Mediterranean mountain fauna (DELTSHEV 1990a). The species *Zodarion pirini* is closely related to some species (*Z. abantense*, *Z. korgei*, *Z. turcicum*) distributed in

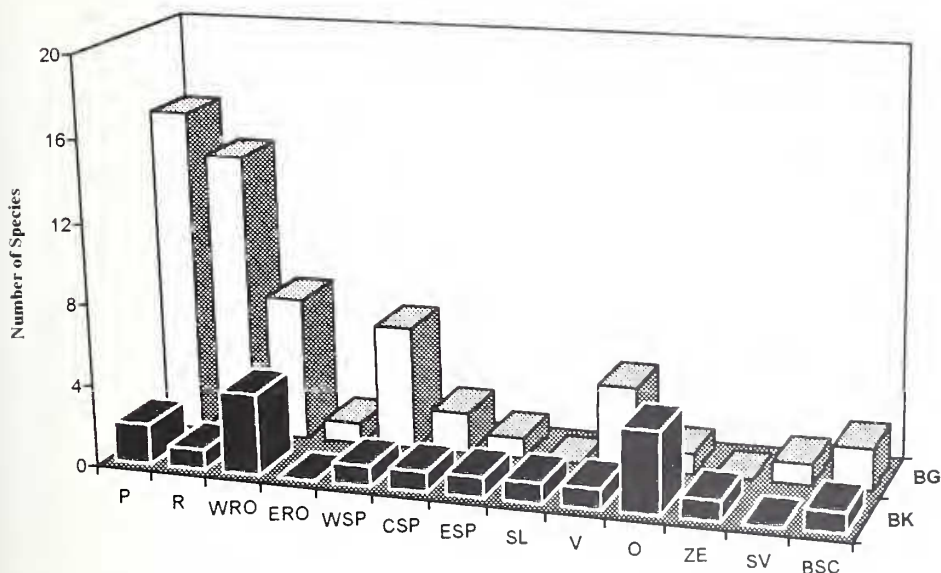


FIG. 2

Distribution of the endemic spiders (Bulgarian/Balkan) in Bulgaria (see Table 1).

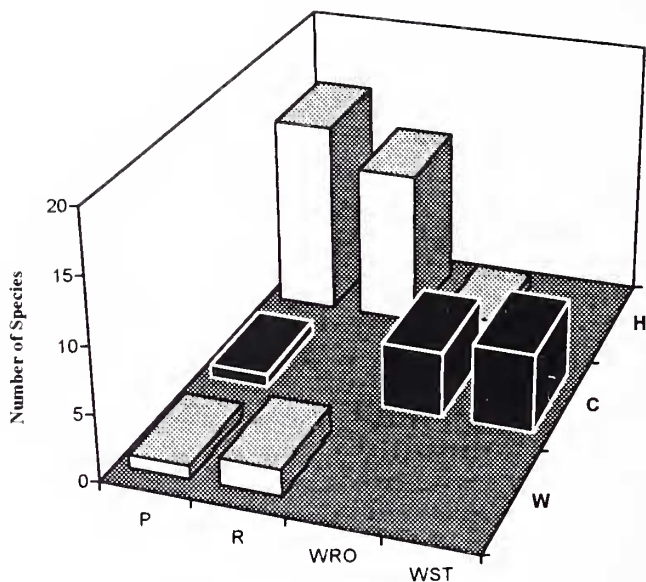


FIG. 3

Distribution of the local endemic spiders in main regions of Bulgaria (see Table 1).

north-eastern part of Mediterranean region. This fact speaks for a possible Mediterranean Origin. The recent distribution of genera *Coelotes* and *Tegenaria*, defined also Mediterranean origin, nevertheless that *Coelotes kulczynskii*, *Tegenaria montana* and *T. rilaensis* are closely related to Middle-European *C. inermis* and *T. campestris*. The possible explanation is that these genera realize an expansion in recent time. The species *Araeoncus clivifrons*, *Diplocephalus altimontanus*, *Drepanotylus pirinicus*, *Erigone pirini*, *Lepthyphantes lithoclasticolus*, *Metopobacterus orbrelicus*, *Cryphoecca pirini* known only from the high alpine parts of Pirin and Rila are high alpine elements. Here can be put also *Pardosa drenska*, occurring the high altitude belts of Pirin Rila and Vitosha. These species are regarded as derivatives of their respective North or Middle European species (*Diplocephalus picinus*, *Drepanotylus borealis*, *Erigone longipalpis*, *Lepthyphantes armatus*, *Metopobacterus prominulus*, *Cryphoecca silvicola*, *Pardosa saltuaria*), due to the disjunction of ranges during the glacial and interglacial (DELTSHEV 1995). The group of cave endemic spiders has similar presence, 17 (39.43%) as the group of high altitude species. They are distributed in the caves of mountains: West Rhodope 5/3, West Stara planina 6/1, Central Stara planina 2/1, East Stara planina 1/1 and Pirin, Slavianka (1), East Rhodope, Osogovo by 1/ species. The caves constitute biotopes limited in their area

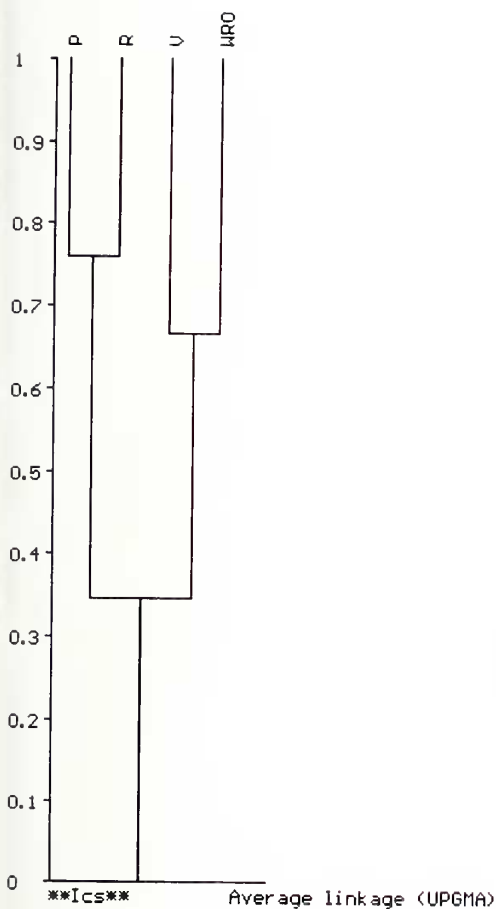


FIG. 4

Dendrogram of the similarity of endemic spiders in high altitude zones of Bulgaria (see table 1).

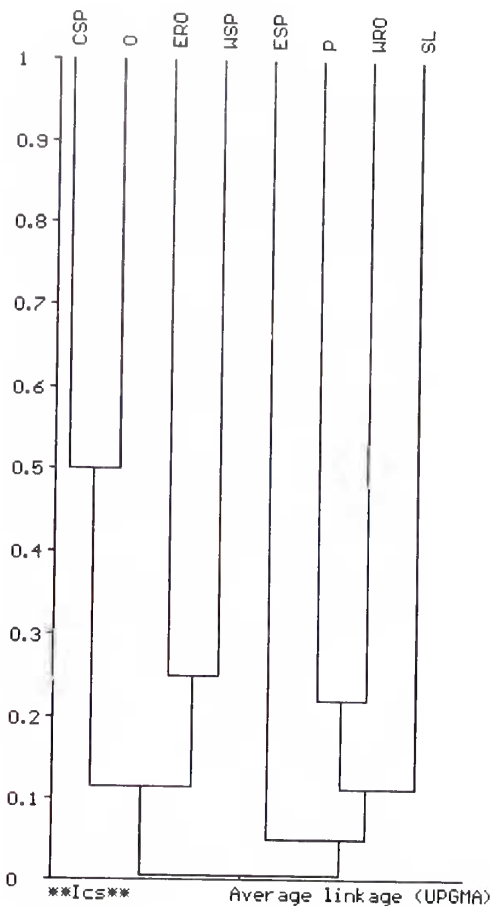


FIG. 5

Dendrogram of the similarity of endemic cave dwelling spiders on Bulgaria (see table 1).

and therefore isolation is a major factor influencing the development of their fauna. This explains the lack or very low level of similarity (30%) between cave endemic complexes of different regions (fig. 5). Concerning the time of its formation, DEELEMEN-REINHOLD (1976) wrote that "many European cave spiders are probably relics of populations of moist Tertiary forests".

Due to the lack of knowledge, it is difficult to determine with certainty which of the cave spiders endemics of Bulgaria are Tertiary and which are Quaternary elements. Nevertheless, the genus *Antrohyphantes* will be mentioned again as an

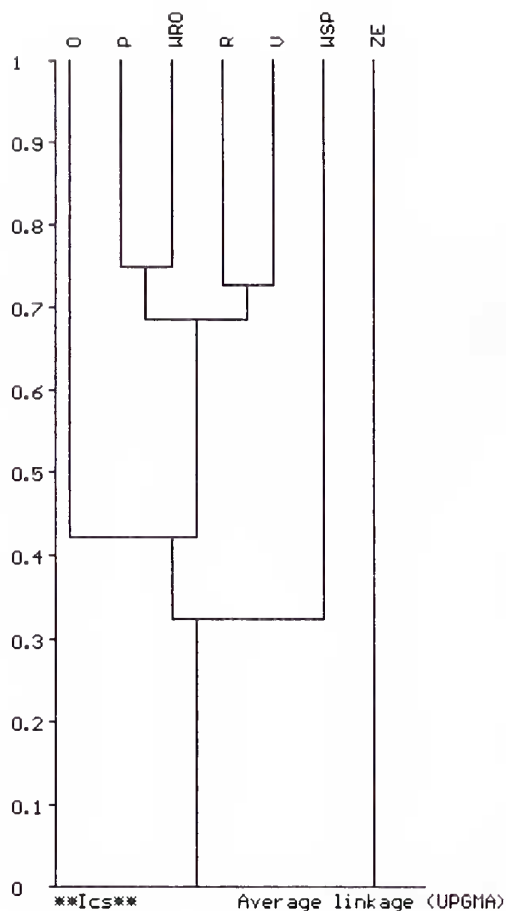


FIG. 6

Dendrogram of the similarity of endemic spiders in woodland zone of Bulgaria (see table 1).

ancient element. He is related to genus *Fageiella*, endemic for the caves of western part of Balkan peninsula (fig. 1). Their allopatric distribution comes to show that they had already spread before the establishing of the Vardar tectonic zone (DELTSHEV 1988). This fact determine the genera as paleoendemics.

The species *Centromerus bulgarianus* and *Troglohyphantes drenskii* are the single blind endemics, occurring the Bulgarian caves and they can be regarded also as probable paleoendemics.

In family Leptonetidae the genus *Protoleptoneta* is provided with the most simple genital organs and may be the oldest group. Similar is the situation with

Troglohyphantes bureschianus, placed in the group of *croaticus*, due to his primitive, three branched paracymbium. So, DEELEMEN-REINHOLD (1978) suggested an origin for the *croaticus* group in South Balkan during the Pliocene.

A present day example of cave penetration are the species *Lepthyphantes centromeroïdes* and *L. spelaeoruni*, comparatively widespread in Balkan peninsula. They occur in caves but also in humus and ground detritus and give a performance of active subterranean colonization (DEELEMEN-REINHOLD 1978).

The endemic species characteristic of woodlands (27.90%) are distributed in the mountains: Rila (5/1), Osogovo (1/5), Pirin (4/1), Vitosha (4/1), West Rhodope (2/1) and Zemenska planina (1).

According to the level of similarity two main endemic complexes can be differentiated (fig. 6). The first includes Pirin and West Rhodope endemics at a high level of similarity above 70%. Very close to this is the second complex of Rila and Vitosha endemics at a level of similarity around 70%. The endemics of Osogovo is connected to the first complexes at a level around 40%, while the isolated position of Zemenska planina in all probability is due to the low number of species.

The recent woodlands fauna is formed after gradual changes on the fauna of the ancient humid Mediterranean forests. This is in concordance with the fact that endemic species found in the forest of Bulgaria belong to genera (*Dasumia*, *Dysdera*, *Zodarion*, *Coelotes*, *Tegenaria*) with possible Mediterranean origin. In the woodlands is established the greatest number of Balkan endemics (6, 14%). These are the species *Dasumia kusceri*, *Dysdera pectinata*, *Zodarion ochridense*, *Coelotes jurinitschi*, *C. karlinskii*, *Tegenaria regispyrri* and they also can be regarded as expansive species. The remaining species *Zodarion pirini*, *Lepthyphantes drenskii*, *Coelotes kulczynskii*, *Tegenaria montana*, *T. rilaensis* and *Calobius balcanicus* also, can be consider as derivatives of old Mediterranean woodland fauna. The distribution of *Coelotes kulczynskii* show tendency of expansion and his establishing in the neighbour mountains of Macedonia and Serbia is quite possible.

The group of lowland elements is small (3) and represents 6.97%. The species *Pachygnatha clerckoides* is a Balkan version of the holarctic *P. clercki*. Surely, this species is widespread in the region, which will be established after revision of all records of *Pachygnatha clercki*. Concerning the origin, the situation with *Centromerus valkanovi* is similar. The species belongs to the group of holarctic *Centromerus sylvaticus*. He is consider as a local endemic, known only from a single locality in coastal habitats of detritus. The range of *Pardosa roscai* show pontic distribution pattern with tendency to extension (Struma valley). He is closely related to *Pardosa cribrata*, which speaks for mediterranean origin.

DISCUSSION

From the found 43 endemic species in Bulgaria, 11 (25.58%) can be consider as Balkan. But, the bigger number (32) and percentage (74.41%) of Bulgarian endemics and certainly the presence of paleoendemic genus *Antrolyphantes* show the importance of Eastern part of Balkan peninsula for the speciation in the region.

The distribution of the most of Balkan species shows expansion, while Bulgarian endemics are considered as local elements (*Coelotes kulczyński* excepted).

The local elements show quite well the history of the region and comprise paleoendemics (mainly in caves) and neoendemics (mainly in high altitude zones). The greatest number of local endemics established in high altitude and woodland belts of Pirin (15) and Rila (12) and in caves and woodland zone of West Rhodope (6) and West Stara planina (6), defines these regions as possible centres of speciation (fig. 3).

According to their origin the endemics belong to two principle faunistic complexes: Mediterranean and European. The Mediterranean elements are distributed in caves, forests, high altitudes and lowlands, while the European – mainly in high altitudes.

The origin and formation of endemic spiders in Bulgaria, can be regarded as a result of the relative isolation of the mountains compared with the zonal areas, in the context of paleo-environmental changes since Pliocene.

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